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show that, in southern California, at least, some of the Mission Indian women were rather adept potters, and indeed the art has not yet become extinct among them.

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INDIAN NOTES AND MONOGRAPHS

EDITED BY F. W. HODGE

VOL. VII No. 2

A SERIES OF PUBLICATIONS RELATING TO THE AMERICAN ABORIGINES

MORPHOLOGICAL AND METRICAL VARIATION IN SKULLS FROM SAN MIGUEL ISLAND, CALIFORNIA

I

THE SUTURA NASOFRONTALIS

BY

BRUNO OETTEKING

NEW YORK
MUSEUM OF THE AMERICAN INDIAN
HEYE FOUNDATION
1920

THIS series of INDIAN NOTES AND MONOGRAPHS is devoted primarily to the publication of the results of studies by members of the staff of the Museum of the American Indian, Heye Foundation, and is uniform with HISPANIC NOTES AND MONOGRAPHS, published by the Hispanic Society of America, with which organization this Museum is in cordial coöperation.

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PREFACE

This article, the first of a series pertaining to morphological and metrical variation in skulls from San Miguel island, California, is based on a collection of skeletal material gathered by Mr Ralph Glidden during excavations made in behalf of the Museum of the American Indian, Heye Foundation, in 1919. This archeological work was made possible by the generosity of Mrs Thea Heye, whose interest in this and in many other ways has been so manifest since the Museum was founded.

The text-figures, reproduced in natural size, are from drawings by Mr William Baake.

MORPHOLOGICAL AND METRICAL VARIATION IN SKULLS FROM SAN MIGUEL ISLAND, CALIFORNIA

I. THE SUTURA NASOFRONTALIS

By Bruno Oetteking

INTRODUCTION

IT IS not only the racial differences in the anatomy of man that evoke the interest of the anthropologist; on the contrary, it could not escape his attention that, even within a racially defined group, variability of different degree is often an outstanding feature, be it somatological or morphological. A systematic inquiry into this phenomenon should be well worth undertaking. It lies in the nature of such a task, however, that the

discussion of single features from anatomical complexes, unproductive as it might seem, cannot be avoided. This might be compensated by not losing sight of the genetic side of the problems under discussion.

An immediate incentive for the work proposed here was the accession to the collections of the Museum of the American Indian, Heye Foundation, of a series of skeletal remains from a circumscribed area, namely, San Miguel island, California, the northwesternmost of the six Channel islands. Of these the three northerly islands, Santa Cruz, Santa Rosa, and San Miguel, were inhabited by Chumash Indians,[1] the three southerly ones, Santa Catalina, San Clemente, and San Nicolas, by Indians of Shoshonean affinity.

The skeletal remains from San Miguel island, known as the Mrs Thea Heye Collection, 1919, include ninety skulls,[2] most of them in an excellent state of preservation. Eighty-eight of the skulls were utilizable for the examination of the sutura nasofrontalis, namely, sixty-six males, sixteen females, one juvenile, and three infants.

Two abnormal cases are given a special description (see pp. 67–68). Of the infants, two have their first molars erupted, two not. They might, therefore, be assigned to the infantile stages II and I. The adult skulls are almost all of mature age. Sexing the adult skulls was as risky here as in any other series. Although the true female type of the Indians is in many instances remarkable for its small size, and sexing therefore materially facilitated, the consideration of this character alone will not do full justice to the problem. And as the other more or less reliable criteria allow of very limited application only, the sexual classification in the present series does not pretend to be in any way conclusive.

All the skulls are undeformed, bearing no indication of either intentional deformation or unintentional cradle-board pressure. This is contrary to the statement of Carr (1897, 283), who asserts that "in twenty-three per cent there is evidence of posterior flattening, due without doubt to cradle-board pressure, though in no case was it sufficient to interfere with the accuracy of

our measurements." Matiegka (1904) also found slight depressions in the obelion region.

It is the author's intention to discuss in successive articles different morphological traits within this single series of skulls.

ORIENTATION AND LANDMARKS

Regarding the anatomical configuration of the nasofrontal region (see fig. 1), there are, in the main, three different bones par-

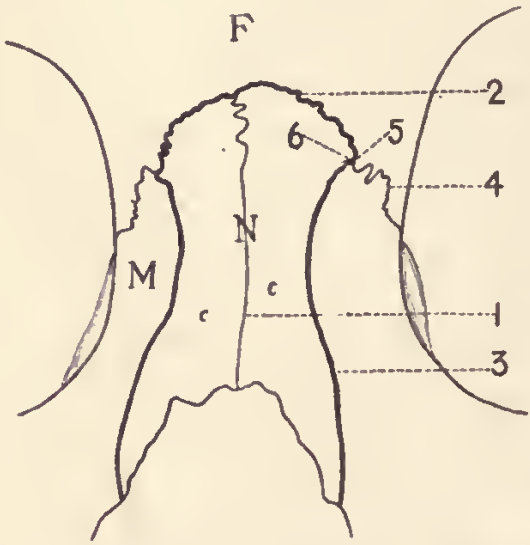


FIG. 1.—Diagram of orientation. *F* = Os frontale (processus nasalis); *M* = Os maxillare (proc. frontalis); *N* = Os nasale; 1 = sutura internasalis; 2 = sut. nasofrontalis; 3 = sut. nasomaxillaris; 4 = sut. maxillofrontalis; 5 = fronto-naso-maxillare (fnm); 6 = maxillo-naso-frontale (mnf).

ticipating. One, the os nasale (N), paired and articulating medially in the sutura internasalis (1), is an independent bone. It articulates with the apophyses of two other bones, superiorly with the processus nasalis (F) of the os frontale in the sutura nasofrontalis (2); laterally, right and left, with the processus frontalis (M) of the os maxillare in the sutura nasomaxillaris (3). The two apophyses again on either side, viz., the processus nasalis of the os frontale and the processus frontalis of the os maxillare, articulate in the sutura maxillofrontalis (4). This suture, meeting at its medial termination upon the suture along the lateral edge of the os nasale, divides it into its two parts as enumerated above—the suturæ nasomaxillaris and nasofrontalis. Being of anthropological interest and lacking a proper designation, I propose to call this meeting point either maxillo-naso-frontale (6) or fronto-naso-maxillare (5), according to its geometrical valuation. Symbolized as "mnf" and "fnm," the former would then represent the vertex of a medially open angle formed by the suturæ naso-

frontalis and nasomaxillaris;[3] the latter would, on the contrary, be the vertex of a laterally open angle formed by the suturæ nasofrontalis and frontomaxillaris.

The orbital outlines in fig. 1 serve only to complete the general aspect; they are of no concern in this specific inquiry.

GENERAL DESCRIPTIVE REMARKS

Throughout the entire series the suture lies rather open, or flat, in the sense of the frontal plane. Depressions in the nasion region are therefore exceedingly scarce, and then only in a mild form. This means that the nasal process of the frontal bone and the proximal ends of the nasal bones articulate almost in a plane, the one not being set off against the other by any pronounced depression.

The course or character of the nasofrontal suture exhibits very little variety. The coarsely plain and even rugged courses predominate. The few instances of livelier movement show more or less regular dentations, and sometimes meandering courses.

In a number of cases an incisura nasalis superior was plainly evident. This formation corresponds with a similar one at the distal edge somewhat medially, both incisures, the upper as well as the lower, being indicative of the bipartite *anlage* of each nasal bone (Perna).[4]

There occurs not infrequently a broadening of the upper parts of the nasal bones, projecting on either side angularly between the nasal and frontal processes of the frontal and maxillary bones. This is the processus lateralis s. orbitalis (Perna, 1906, 124), which in case of strong development may articulate with the pars lacrimalis of the processus frontalis maxillæ, a somewhat anomalous condition due to complications in the osteogenetic process in the fronto-maxillary region.

Synostosis of the naso-frontal suture was entirely absent in this series, and not even indicated in the senile specimens. This statement is in accordance with Frédéric's (1909, 409) observation on certain sutures of the face, "die sehr selten synostosieren." Claimed by Manouvrier (1893) to be a

racial peculiarity of the pre-Columbians of Venezuela, its occurrence has since been shown in European skulls also.

FORM AND CHARACTER OF THE SUTURA NASOFRONTALIS

The course of the suture is generally described as being of horizontal, or arched, or angular form, both the convexity and the vertex of the angle encroaching on the nasal process of the frontal bone. A closer examination of these conditions admits of further differentiation, giving rise to subdivisions of rather distinct appearance. Progressing from the simplest to the more specialized ones, I succeeded in distinguishing six different varieties, which may be successively educed in the following, by representing each of them by a scheme and an individual case from the series. It must be stated, however, that variation requires a liberal margin in each of the varieties, and that the absolutely true and exemplary cases are rather few. Some of the forms described here bear certain affinities to such as are met with in the anthropoid apes.

But, although there are characteristic and also typical forms, the naso-frontal suture there, and in the catarrhines in general, proved so varied after a superficial review of actual specimens and the literature at hand, that the matter may well merit special inquiry.

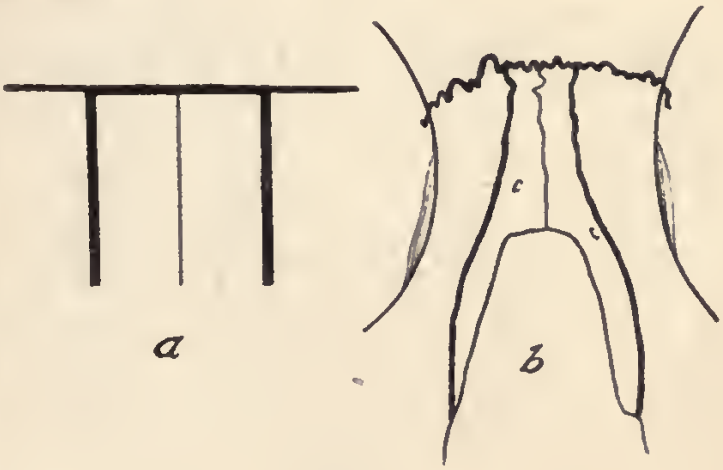


FIG. 2

A. 318 (fig. 2). The suture has a rather horizontal course, forming angles around 90° with the naso-maxillary suture, the maxillo-naso-frontalia being the vertices. The constriction of the latter suture, lateral-mesially, is as a rule inconsiderable. Naturally the inferior border of the nasal process of the frontal bone is directed hori-

zontally in most of the cases, a state which further implies that the course of the naso-frontal suture is continued more or less horizontally into the fronto-maxillary suture.

B. 291 (fig. 3). This modification of the preceding condition presents the naso-frontal suture slightly curved toward the

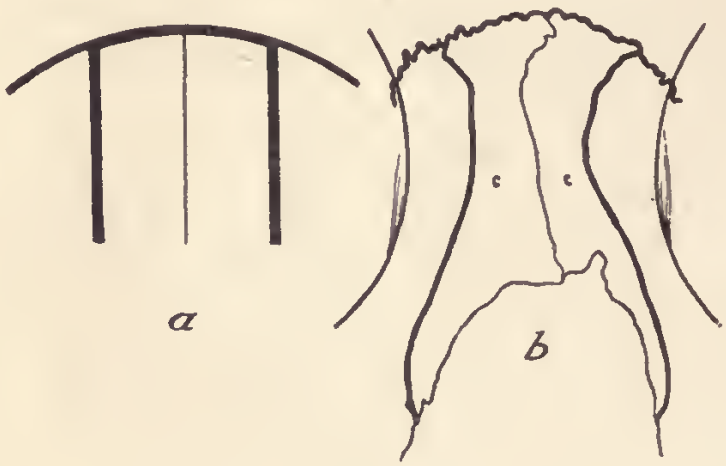


FIG. 3

frontal bone, or, more accurately, the nasal process of the latter. The length of the suture is quite variable, involving in cases considerable constriction of the naso-maxillary sutures.

The specific feature respecting varieties A and B is the direct continuance of the course of the naso-frontal suture into the

fronto-maxillary suture of either side, a condition already pointed out under A. An angular break, on the contrary, occurs between the two sutures in the fronto-naso-maxillary points, in the varieties C to F, which will be shown in the following paragraphs.

C. 300 (fig. 4). The suture assumes the form of a semicircular arch or a modifica-

FIG. 4

tion of it, set off angularly in the fronto-naso-maxillaria. The naso-maxillary sutures are here as under A, constricted only slightly. There are, however, cases of more pronounced constriction, coinciding with semicircular naso-frontal sutures of shorter length.

D. 294 (fig. 5). The flattening-out of the preceding semicircular form of the naso-frontal suture from above and laterally produces a rectangular form. Where the constriction of the naso-maxillary sutures is but slight, these sutures are carried uninterruptedly into the lateral parts of the naso-frontal sutures. The angles formed by

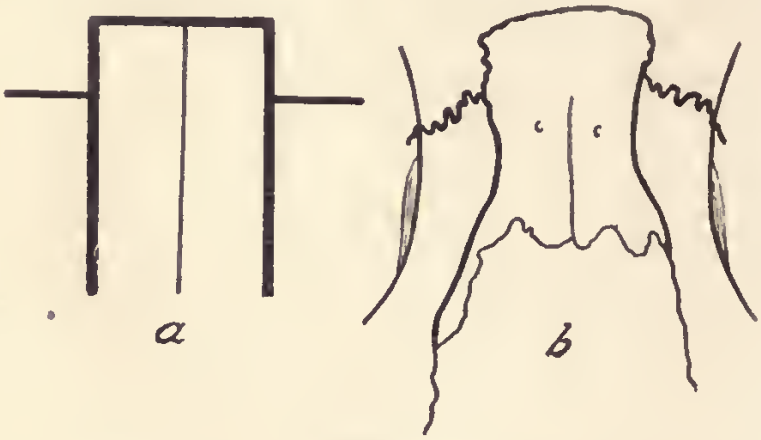


FIG. 5

the latter and the maxillo-frontal sutures tend toward right angles. The rectangles above the maxillo-naso-frontal points appear in various shapes, such as broad, medium broad, high, and low, as well as showing combinations between the four.

E. 337 (fig. 6). A modification of the rectangular form of the suture, as described

under D, is given when the two sides converge from laterally below to mesially above, where their ends are connected by an upper right horizontal. The connection of the maxillo-naso-frontal points by an imaginary horizontal would result in the geometric figure of a trapezoid. The angles

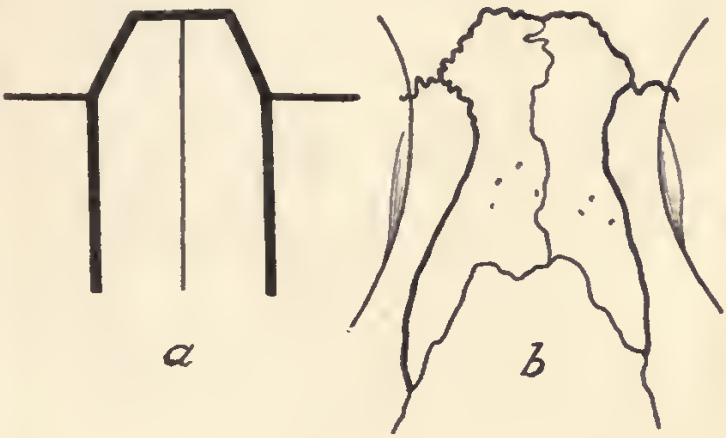


FIG. 6

formed, first, by the upper horizontal and the two lateral sides; secondly, by these and the naso-maxillary suture, the maxillo-naso-frontal points being the vertices, tend toward obtuseness.. The constriction of the naso-maxillary sutures is only mildly pronounced, owing perhaps to, and correlated with, the fact that in this variety

the proportions of the nasal bones are rather large, a condition which apparently saves them from being narrowed in by the frontal processes of the maxillary bone.

F. 260 (fig. 7). A modification of form E occurs when the lateral slanting sides of the naso-frontal suture meet above to form

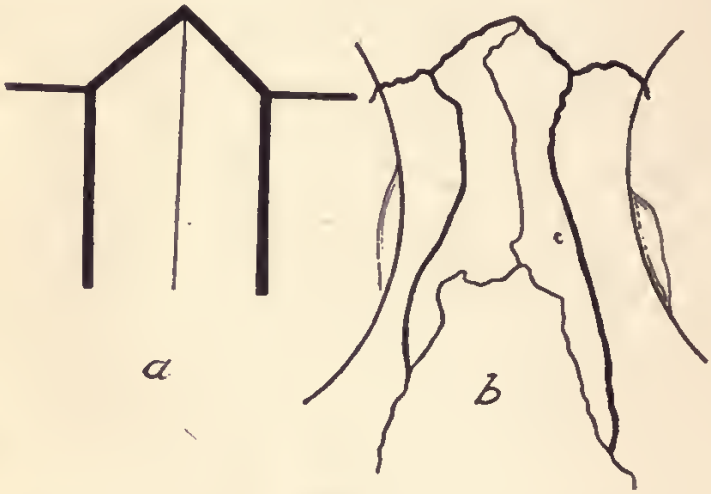
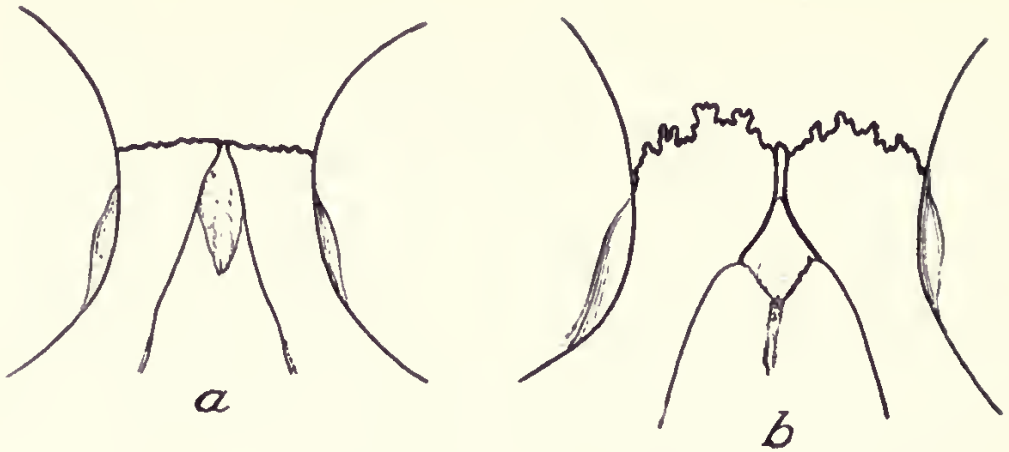


FIG. 7

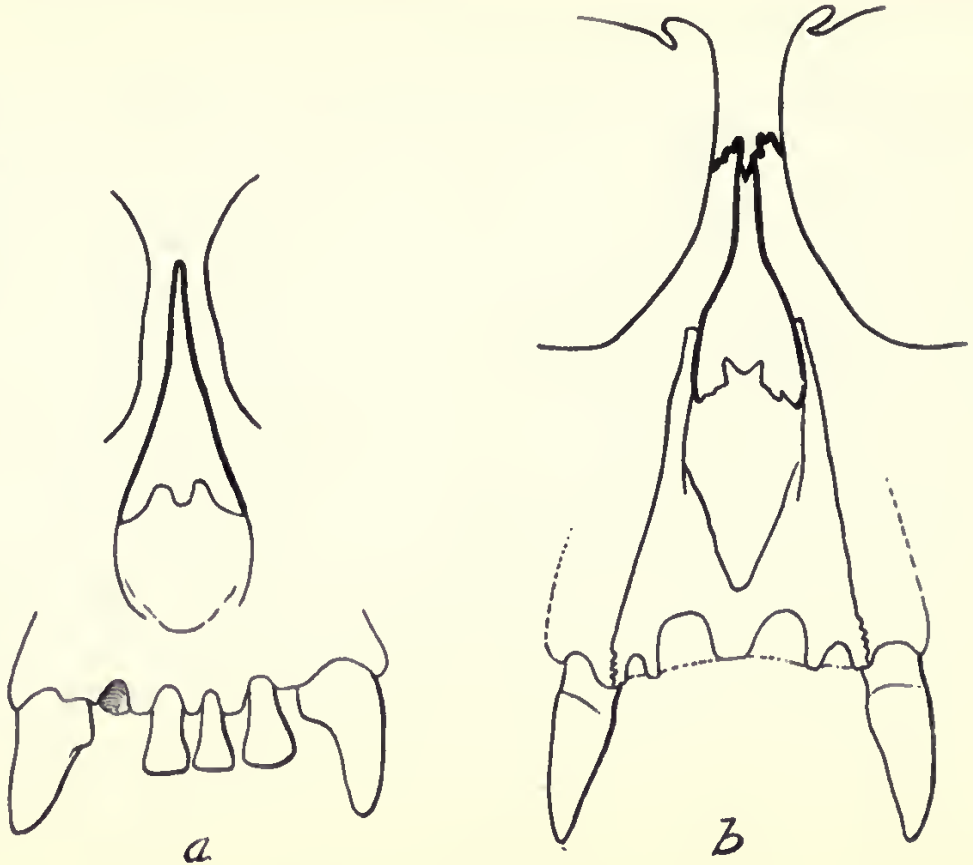
an angle. This angle lies in most cases around 90°, while the angles produced by the lateral parts of the naso-frontal suture and naso-maxillary sutures turn out somewhat smaller, conforming to the amount of constriction to which the latter sutures are subjected.

Repeating in part the remark under B, it



TWO CASES OF CATARRHINY

a = no. 259 mature; *b* = 267 infans I



TWO TYPICAL CASES OF SIMIAN CATARRHINY, TO WHICH THOSE OF PLATE I ARE LIKENED

a = Cebus; *b* = Macacus (after Oppenheim)

might be stated again that the distinct peculiarity of varieties C to F lies, besides the characteristic courses of the naso-frontal suture, with the lateral angularity. Owing to the multifarious conditions of the two factors involved, viz., the naso-frontal suture itself and the naso-maxillary sutures, it is only natural that their angularity also should be considerably variable. It is not intended here to inquire into this at length; having pointed out the two contradistinguishing conditions must suffice.

There are in the present series two cases (nos. 259 mature, and 267 infans I) of special interest, both somewhat abnormal (see pl. I, *a*, *b*). They obviously represent the condition of "catarrhiny"[5] as described by R. Virchow, who likened it to similar conditions in the platyrrhine genus of *Cebus*, without any pretense, however, of homologizing the two. The cases show the characteristic narrowing of the nasal bones toward the nasal process of the frontal, where their width at the naso-frontal suture measures 1 mm. The bones are distally defective. A special feature of no. 259 is, on either side,

the course of the fronto-maxillary suture, which first turns upward from the fronto-naso-maxillary points and then changes to horizontal. It closely resembles the case of a *Macacus* as figured by Oppenheim, 1911, pl. II, no. 3, also no. 5 (see pl. II, *b*), while no. 267 of the two cases under discussion finds its analogy in no. 2 in the same plate, this being the case of a *Cebus* (see pl. II, *a*).

MEASUREMENTS (See Tables I and II)

1. *The direct length of the naso-frontal suture.*—By direct length of the naso-frontal suture is meant the direct connection between the maxillo-naso-frontal point of one side and that of the other, regardless of the sutural excursion upon the nasal process of the frontal bone (5–5, fig. 1). This measurement, at the same time, represents the width of the nasal bones in that region. But as only the suture there is under discussion, the measurement refers to it. The treatment of the relative proportion between the direct length of the naso-frontal suture and the *minimum*

width of the nasal bones, however, is carried out further below (see under 5).

The direct length yields from sixty-six males an average[6] of 10.7 mm. Sixteen females come to 9.6 mm., and three infants to 11.0 mm. The only juvenile has also 11.0 mm. For the somewhat higher male average over the female, the difference of physical size of the crania must not be overlooked. The possibility of a correlation between the forms and size of the suture will be touched upon below. The apparent disproportion between the averages of the matures and immatures, the latter exceeding the former, is due without doubt to the small number of immatures.

The total range of variation runs from 6 mm. to 16 mm. It is equivalent to the male extension proper, while the female one covers values from 7 mm. to 13 mm., and the infantile from 9 mm. to 14 mm.

Distributed among the six different forms of the naso-frontal suture, the highest male mean[7] of 12.7 mm. occurs in the trapezoidal variety. 11.4 mm. is the male mean of both the curved and the semicircular forms,

while the rectangular one yields 10.3 mm. The lowest male mean of 8 mm. is produced by the straight form, and a little higher, at 9.1 mm., stand the males of the angular form. The female means fall, wherever they occur, a trifle (about 1 mm.) below the male ones.

2. *The anterior interorbital width.*—This measurement comprises the two maxillo-frontalia,[8] by which the width of the nasal process of the frontal bone should also properly be estimated. There occurs a male average of 17.5 mm. at a range from 14 mm. to 27 mm. The females, with 16.7 mm., fall a little lower, their range extending from 12 mm. to 19 mm. An average of 16.7 mm., uniform with the female one, is also produced by the three infants whose individual values run from 15 mm. to 18 mm. The juvenile has an anterior interorbital width of only 16 mm.[9]

The six different varieties of the naso-frontal suture participate in such a way that the highest male mean of 19.4 mm. is due to the curved form. The means then graduate away very evenly with 18.4 mm.

in the rectangular, 17.4 mm. in the semicircular, 17.0 mm. in the trapezoidal, 16.5 mm. in the angular, and 15.0 mm. in the straight forms. The females follow in the same order, with means a little below the male ones.

3. *The minimum width of the nasal bones.*—The minimum width of the nasal bones is to be taken wherever it occurs, and as a rule parallel with the horizontal position of the skull. Special cases (for instance, irregular lateral constriction of the two nasal bones) justify a deviation from that rule, the horizon of the measurement then assuming an angular position to the general plane of orientation. Most generally the minimum width will be met with at about the union of the upper third and the lower two-thirds of the nasal bones, although it occasionally occurs above or below this level.

The minimum width of the nasal bones remains in all cases, except one where it equals it, below the direct width of the naso-frontal suture. In sixty-six males it amounts to 7.2 mm., sixteen females coming

to the same average. The only juvenile with a minimum width of 7 mm. is outranged, as are the two adult averages, by the three infants at 8.3 mm. The latter's individual values, at 7 mm., 8 mm., and 10 mm., fall well within the total range of variation, 3 mm. to 12 mm., which here also corresponds to the extension of the male range. The female range starts at 5 mm. and ends at 10 mm.

The means turn out to be somewhat more variable. The highest male means at 8.0 mm. each are seen in the semicircular and trapezoidal varieties. A mean of 7.5 mm. is yielded by the rectangular, 6.9 mm. by the curved, 6.4 mm. by the angular, and the lowest, 5.2 mm., by the straight form of the suture.

4. *The naso-frontal–interorbital index:*

$$\frac{\textit{direct length of naso-frontal suture} \times 100}{\textit{anterior interorbital width}}$$

This index is well adapted to disclose the relative proportion between the two factors indicated above. The lower index will then stand for a shorter direct length of the naso-frontal suture, or, as it were, a broader nasal

process; a higher index for a more extended direct naso-frontal suture, or, as it were, a narrower nasal process. Both factors being exceedingly variable, it follows that the index should be the same. The index ranges from 35.0 to 87.3 in the males, and from 46.7 to 81.3 in the females, giving rise to averages of 61.6 in the former and 60.3 in the latter. Even the three infants' individual values disagree greatly at 58.8, 60.0, and 77.8, their average being 65.5. The only juvenile has as high an index as 68.8. It is not astonishing, therefore, that the Standard Deviation shows high figures, indicating a male variability of ± 12.39, and a female one of ± 8.25.

The group means also disagree considerably. The highest male mean of 73.8 is claimed by the trapezoidal form of the suture, the lowest one of 53.1 by the straight one. The rectangular group has a mean of 56.1, and gradually rising are seen the angular one with 58.5, and the curved one with 59.3. Between the latter and the highest mean falls that of the semicircular variety with a mean of 65.6. Some disparity is

here exhibited between the male and the female means. While those of the semicircular variety are perfectly alike at 65.6 and 65.8, the female mean of the rectangular group amounts to 51.9 against the male one of 56.1, and the female one of the angular group to 62.3 against the male one of 58.5.

The mutual dependency of two such variable factors as are involved in this index renders a definite analysis rather difficult. The extreme individual values of the total range, however, show for the highest ones, as well as for the lowest, thoroughly plausible relations, namely: $13 \cdot 100:15 = 86.7$ (no. 312); $14 \cdot 100:16 = 87.5$ (no. 315); and: $7 \cdot 100:20 = 35.0$ (no. 274); $8 \cdot 100:20 = 40.0$ (no. 281), i.e., the first two have a long, the latter two a short, direct sutural length. The conditions are clouded, however, when it comes to an analysis of the group means. Still, there are instances to show, like the means of the trapezoidal and semicircular groups, that the higher means depend on the greater length of the nasofrontal suture, while this same length in the

curved form is offset by a high anterior interorbital width.

5. *The naso-frontal–nasal index:*

$$\frac{\textit{minimum width of nasal bones} \times 100}{\textit{direct length of naso-frontal suture}}$$

The relative proportion between the direct length of the naso-frontal suture and the minimum width of the nasal bones might be expressed in an index, appropriately termed naso-frontal–nasal index, inasmuch as its first named constituent is only another expression for the width of the nasal bones in that region. The index then denotes the relative degree of direct extension of the naso-frontal suture as well as that of relative constriction of the nasal bones. The condition of excessive variableness of the two factors involved is reflected by the index, as was also the status of the preceding one.

The range of variation of all the males extends from 35.7 to 100.0, the latter being a case of equality of both measurements. The female range covers values from 66.7 to 87.5. Their averages amount to 69.0 in the former and to 75.4 in the latter. The reason for the disparity in the two adult

averages, the female exceeding the male, is plainly seen in the difference of their sutural averages (see table 1), the male having

TABLE I.—SUMMARY OF FREQUENCY AND AVERAGES

Sexes (adult) and immature ages	Cases	Percental frequency	1 Direct width of naso frontal suture	2 Anterior interorbital width (mf–mf)	3 Minimum width of nasal bones	4 Index: $\frac{1\times100}{2}$	5 Index: $\frac{3\times100}{1}$
			mm.	*mm.*	*mm.*		
♂	66	77%	10.7 (6–16)	17.5 (14–27)	7.2 (3–12)	61.6 (35.0–87.5) $\sigma = \pm 12.39$	67.5 (37.5–100.0) $\sigma = \pm 12.28$
♀	16	19%	9.6 (7–13)	16.7 (12–19)	7.2 (5–10)	60.3 (46.7–81.3) $\sigma = \pm 8.25$	75.4 (66.7–87.5) $\sigma = \pm 5.85$
juv	1	1%	11.0	16.0	7.0	68.8	63.6
inf	3	3%	11.0 (9–14)	16.7 (15–18)	8.3 (7–10)	65.5 (55.8–77.8)	76.4 (71.4–80.0)

10.7 mm., the female 9.6 mm., while both hold the same minimum width average of 7.2 mm. Exceeding the female index average is shown that of the three infants at

76.4 from individual values of 71.4, 77.8, and 80.0. The juvenile's index is 63.6.

The Standard Deviation for the males corresponds with ±12.28 to that of the preceding index, while the females reveal a variability of only ±5.85.

The group means manifest a no less decided unsteadiness. The highest male mean of 72.6 is reached by the rectangular variety, the same that contains the individual case of a 100.0 index. A male average of 70.4 is yielded by the semicircular group. The means then drop to 66.0 in the angular, 65.9 in the straight, 63.0 in the trapezoidal, and 61.2 in the curved form. A strange feature here is that all the female means, wherever they occur, exceed those of the males. The determining factor here, as for the group means in general, lies with the different degree of variableness, which appears to be less pronounced in the minimum width of the nasal bones.

The metrical findings in the classifications of sex and age being established (see table I), and the groupwise treatment completed (see table II), it remains to examine the

TABLE II.—DISTRIBUTION OF THE CASES AMONG THE SIX VARIETIES OF THE NASO-FRONTAL SUTURE. SUMMARY OF FREQUENCY AND MEANS

	A			B			C			D			E				F		
Forms of frontal suture	straight			curved			semicircular			rectangular			trapezoidal				angular		
Cases	♂ 5	♀ -	*inf* -	♂ 8	♀ -	*inf* 1	♂ 24	♀ 8	*inf* -	♂ 12	♀ 4	*inf* 1	♂ 6	♀ -	*juv* 1	*inf* 1	♂ 11	♀ 4	*inf* -
Total and percental	5 =6%			9 =11%			32 =37%			17 =20%			8 =9%				15 =17%		
1. Direct length of naso-frontal suture (mm.)	8.0 (6–11)	-	-	11.4 (8–16)	-	9.0	11.4 (7–14)	10.5 (9–13)	-	10.3 (7–12)	8.8 (7–11)	10.0	12.7 (11–15)	-	11.0	14.0	9.1 (8–13)	8.3 (7–10)	-
2. Anterior interorbital width (mm.)	15.0 (14–17)	-	-	19.4 (17–27)	-	15.0	17.4 (14–20)	16.4 (14–19)	-	18.4 (15–21)	16.8 (15–18)	17.0	17.0 (15–20)	-	16.0	18.0	16.5 (14–19)	13.3 (12–16)	-
3. Minimum width of nasal bones (mm.)	5.2 (4–7)	-	-	6.9 (3–10)	-	7.0	8.0 (5–12)	7.9 (6–10)	-	7.5 (4–11)	6.5 (5–9)	8.0	8.0 (7–10)	-	7.0	10.0	6.4 (4–9)	6.5 (5–8)	-
4. Index $\frac{1 \cdot 100}{2}$	53.1 (42.9–68.8)	-	-	59.3 (40.0–80.0)	-	60.0	65.6 (43.8–81.3)	65.8 (52.9–81.3)	-	56.1 (35.0–75.0)	51.9 (46.7–52.9)	58.8	73.8 (55.0–69.2)	-	68.8	77.8	58.5 (50.0–68.4)	62.3 (58.3–66.7)	-
5. Index $\frac{3 \cdot 100}{1}$	65.9 (54.5–71.4)	-	-	61.2 (37.5–83.3)	-	77.8	70.4 (54.5–87.5)	74.7 (66.7–83.3)	-	72.6 (54.5–100.0)	73.7 (66.7–81.8)	80.0	63.0 (58.3–69.2)	-	63.6	71.4	66.0 (50.0–87.5)	78.5 (71.4–87.5)	-

different measurements in direct reference to the range and frequency of the length of the naso-frontal suture. This has been done in table III, where the entire series,

TABLE III.—COMPARATIVE TABLE OF MEASUREMENTS (MEANS) ACCORDING TO THE RANGE AND FREQUENCY OF THE DIRECT LENGTH OF THE NASO-FRONTAL SUTURE

1		2	3	4	5
Direct length of naso-frontal suture		Anterior inter-orbital width	Minimum width of nasal bones	Index: $\frac{1\times100}{2}$	Index: $\frac{3\times100}{1}$
range	frequency				
mm.		*mm.*	*mm.*		
6	2	14.0	4.0	42.9	66.7
7	5	15.4	5.0	46.7	71.4
8	9	15.3	5.8	53.3	72.2
9	14	16.4	6.3	55.9	69.8
10	14	17.4	7.1	57.8	71.4
11	16	18.0	7.3	62.0	65.9
12	9	18.6	8.6	66.4	71.3
13	7	17.1	8.9	76.4	68.1
14	7	18.3	10.0	76.9	71.5
15	2	18.5	9.5	81.1	63.3
16	1	20.0	7.0	80.0	43.8

excepting the two abnormal cases, is represented. The inclusion of the immatures in this table seemed fully justifiable, as they nowise occupy any extreme stations there, but fall well within the general range

of variation. The table is arranged in such a way that the first two columns contain the range of variation in progressive order, and the frequency of cases for each consecutive step. The next four columns present the means of the measurements and indices denoted by their headings, the means being reduced from the sums of the individual values of the same number of cases as listed in the frequency column. The comparative examination of the figures then discloses the interesting fact that, with the greater length of the naso-frontal suture increases the anterior interorbital width in a steadily progressing order, or, which amounts to the same, the nasal process of the frontal bone gains in width. Such proportions obtain also between the sutural length and the minimum width of the nasal bones, and naturally in the indices also, although the latter one of these, which comprises the measurement of the nasal bones, vacillates somewhat. Occasional relapses, doubtless due to the changes in frequency, are of small account compared with the general results derived from this table.

CONCLUSIONS

Concluding this investigation, it may be re-stated that the systematic inquiry into the nature of the naso-frontal suture in skulls of a single series has revealed two outstanding facts: first, the variableness of form, and, secondly, the interdependence of metrical proportions. In regard to the difference of form, it has been stated that the angular form occurs with greater frequency in Europeans, the horizontal in Mongoloids and Negroes (Martin, 843). There was, however, no preference of form to be noticed to justify such an assumption in the case of the present series. The horizontal course which might apply here is represented in only moderate percentages, viz., 6% in the straight course, and 11% in the curved, while the bulk goes to the semicircular, rectangular, and angular forms, with 37%, 20%, and 17% respectively (see table II). The variableness of form of the suture is all the more important or significant, on account of its being found in a series of specimens from a limited and now

deserted locality, the island of San Miguel, California, a fact which should guarantee a certain racial homogeneity. It must be concluded, then, that the form of the naso-frontal suture is, *a priori*, a variable feature, admitting, in this series, of its reduction into six distinct varieties. Of these, the straight and the slightly curved forms continue directly into the fronto-maxillary suture of either side, while the remaining four, the semicircular, rectangular, trapezoidal, and angular forms, are set off angularly against the latter suture in either the maxillo-naso-frontal or fronto-naso-maxillary points (*mihi*). The interdependence of metrical proportions was proved by comparing directly and proportionally the direct length of the naso-frontal suture with the interorbital width (*maxillofrontale*), and the minimum width of the nasal bones. Although the groupwise treatment was apt to show certain conditions with regard to the correlative occurrence of those measurements, it was finally demonstrated that, from a general angle, the interorbital width, as well as the minimum width of the nasal

bones, increases with the growth of the direct length of the naso-frontal suture.

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NOTES

1. The "Handbook of American Indians," 1912, Part 1, page 296, states that, "like most Californian aborigines, they appear to have lacked an appellation of general significance, and the term Chumash, the name of the Santa Rosa Islanders, is arbitrarily chosen for convenience to designate the linguistic stock." *Eisen* (1904), who visited the islands on several occasions, says that, "at the earliest of these visits (1873 and 1897) the Indians had already been totally extinct for twenty years" (page 1); and with special reference to the island of San Miguel, "the island was once thickly populated by Indians" (page 12).

2. Nos. 252–340 and No. 507, Catalogue of the Department of Physical Anthropology, Museum of the American Indian, Heye Foundation.

3. This angle is not always evident, as will be shown later.

4. Perna (1906, 121) reserves the name of incisura nasalis for the cases described above. It is sometimes applied by anthropologists to the arch produced by the distal edges in the union of the nasal bones. The incisura can assume the form of a foramen closed inferiorly, which is said to occur in nasal bones of greater length.

5. Manouvrier (1893, 736) calls it "arrêt de développement de la portion supérieure des os nasaux," quoting two cases from Marquesas islands and Japan, respectively. Matiegka (1904, 12) mentions one case of "Katarrhinie," and another one of "Mässige Katarrhinie."

6. *Averages* are derived here from the major classes, for instance, all the males or females; *means* from the subdivisions as represented by the six different varieties of the naso-frontal suture. For both averages and means, consult the tables.

7. See note 6.

8. The maxillofrontale (mf) is the medial measuring point of the orbital width. It is found at the maxillo-frontal suture, where in its upward turn the continuation of the crista lacrimalis anterior, forming the medial rim of the orbit, meets upon the suture.

9. For comparative figures see Martin, 1914, pp. 664–665.

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